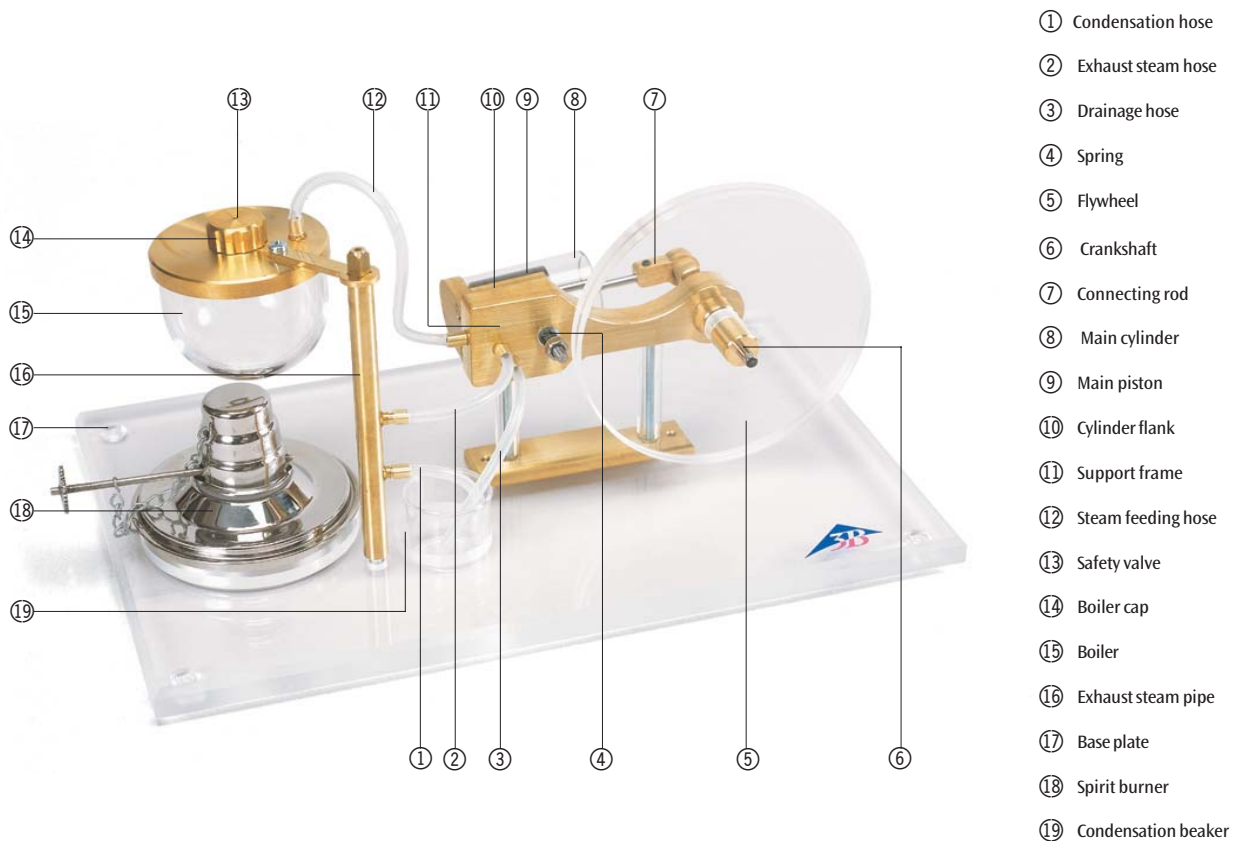


## Steam engine, transparent U10055

### Instruction Sheet

07/05 ALF



- ① Condensation hose
- ② Exhaust steam hose
- ③ Drainage hose
- ④ Spring
- ⑤ Flywheel
- ⑥ Crankshaft
- ⑦ Connecting rod
- ⑧ Main cylinder
- ⑨ Main piston
- ⑩ Cylinder flank
- ⑪ Support frame
- ⑫ Steam feeding hose
- ⑬ Safety valve
- ⑭ Boiler cap
- ⑮ Boiler
- ⑯ Exhaust steam pipe
- ⑰ Base plate
- ⑱ Spirit burner
- ⑲ Condensation beaker

The steam engine is used to demonstrate how an oscillating steam engine functions.

### 1. Safety instructions

- The safety standards applicable to the steam engine are specified in DIN 31000:1979-03.

General safety standards applicable to steam engines	Specific conformance of steam engine U10055
1. No sharp corners or edges	1. There are no sharp corners or edges on this device.
2. Protection against corrosion	2. No materials that are subject to corrosion have been used.
3. Temperature limiting for operating elements	3. The wick of the spirit burner can be adjusted.
4. The boiler capacity of the steam engine may not exceed 2000 cc Maximum operating pressure may not exceed 1.5 bars.	4. The boiler capacity is 50 cc. The operating pressure is 0.5 bars.

General safety standards applicable to steam engines	Specific conformance of steam engine U10055
5. An adjustable spring-operated safety valve made of non-rusting material with a safety threshold of no more than 3.0 bars (double the operating pressure) must be provided.	5. This unit is equipped with an adjustable spring-operated safety valve made of non-rusting material with a safety threshold of 1.0 bar (double the operating pressure)
6. The bursting pressure of the boiler should be no less than 3-times the operating pressure.	6. The boiler's bursting pressure is at least 1.5 bars (at least three times the operating pressure). Each boiler is checked for safety and leaks by means of a burst pressure test (2 bars+).
7. The water level must be visible, if possible, with the aid of an inspection window.	7. The water level is visible at all times because of the glass boiler.
8. An easy to understand instruction sheet is required plus a label with the name or logo of the manufacturer.	8. An instruction sheet is supplied with each apparatus. An appropriate silk-screen printed label is located on the base plate.

- Only put the steam engine into operation if all of the components are in perfect condition and their functionality is assured. Special attention must be made to ensure that there are no cracks or any other damage to the glass boiler ⑮ .
- Only use distilled water that has been demineralised as per VDE 0510. If conventional tap water is used the associated deposits that form on the safety-relevant components mean that functionality can no longer be guaranteed.
- Carefully pour alcohol into the burner ⑱ . Make sure that nothing spills.
- Never pour in alcohol while the wick is still glowing or if there is any other open flame in the immediate proximity.
- Seal the bottle of alcohol immediately after use.
- Keep away from the open flame. Be careful! Only extinguish the burner flame by means of the attached cover. Do not blow on the flame in the proximity of the boiler, as any sudden temperature change could cause the boiler to crack.
- The boiler may not be heated unless it is filled with water. For that reason it is important to extinguish the lamp's flame before it boils dry.
- Do not touch any components steam carrying, particularly the boiler ⑮ , hoses ① , ② , ③ , ⑫ , steam exhaust pipe ⑯ and support frame ⑪ . Do not touch the spirit burner ⑱ during or after operating the steam engine either. Risk of burns!
- Let the steam engine cool before storing.

## 2. Description, technical data

The oscillating steam engine has been designed for use in a training and educational environment. In order that individual operations and dynamic processes should be observable, particular emphasis has been placed on transparent construction. For that reason the main cylinder ⑧ and boiler ⑮ are made of heat-resistant special glass and the flywheel ⑤ is made of acrylic. The hardened crankshaft ⑥ and the connecting rod ⑦ are ball-bearing mounted. The graphite piston ⑨ runs dry in the

operating cylinder – i.e. without any added lubricant. For that reason the steam engine runs very quietly and safely for long periods, providing a mechanical power output of approx. 1 W. The safety valve ⑬ is located in the boiler cap ⑭ . It opens as soon as the boiler pressure exceeds 1.0 bar. In addition, the machine is also equipped with a second, independent excess pressure safety mechanism. Up to a pressure of approx. 1.5 bars the steam is forced into the ducts of the support frame ⑪ and discharged via the condensation hose ① . When the pressure exceeds 1.5 bars the cylinder flank ⑩ is forced away from the frame because the tension in the spring ④ is overcome so that the steam can flow unimpeded out of the steam inlet hole in the frame.

Piston diameter:	19 mm
Piston stroke:	10 mm
Boiler diameter:	50 mm
Boiler volume:	50 ml
Operating time per filling:	approx. 20-25 mins
Speed:	800 rpm
Mech. Power output:	approx. 1 W
Max. operating pressure:	0.5 bars
Trigger pressure of the safety valve:	1.0 bars
Minimum boiler bursting pressure test:	2.0 bars

## 3. How the apparatus works

Unlike a slide-valve steam-engine, an oscillating steam engine has a cylinder that rotates on a central shaft causing steam inlet and outlet ducts to open and close. Water in the boiler begins to boil, and thus steam is generated. The steam flows via the steam inlet hose ⑫ into the frame then through the steam inlet hole. As soon the opening of the cylinder is fed with fresh steam, steam flows into the cylinder and displaces the piston (Fig. 1, a). When the piston reaches its lowest point, the steam ducts are closed. This slack point is passed thanks to the inertia of a flywheel (Fig 1, b). In the next phase, the piston moves back, opens the steam outlet and pushes out the steam

(Fig. 1, c). The steam flows out via the exhaust steam hose ② and the exhaust steam pipe ⑯. The condensed water that accumulates drips out via the condensation hose ① into the condensation beaker ⑱.

When the piston has reached the dead point at the top, both of the steam ducts are closed again. The flywheel drags the engine past this top slack point, after which steam is once again fed in and the procedure repeats from the start (Fig. 1, d).

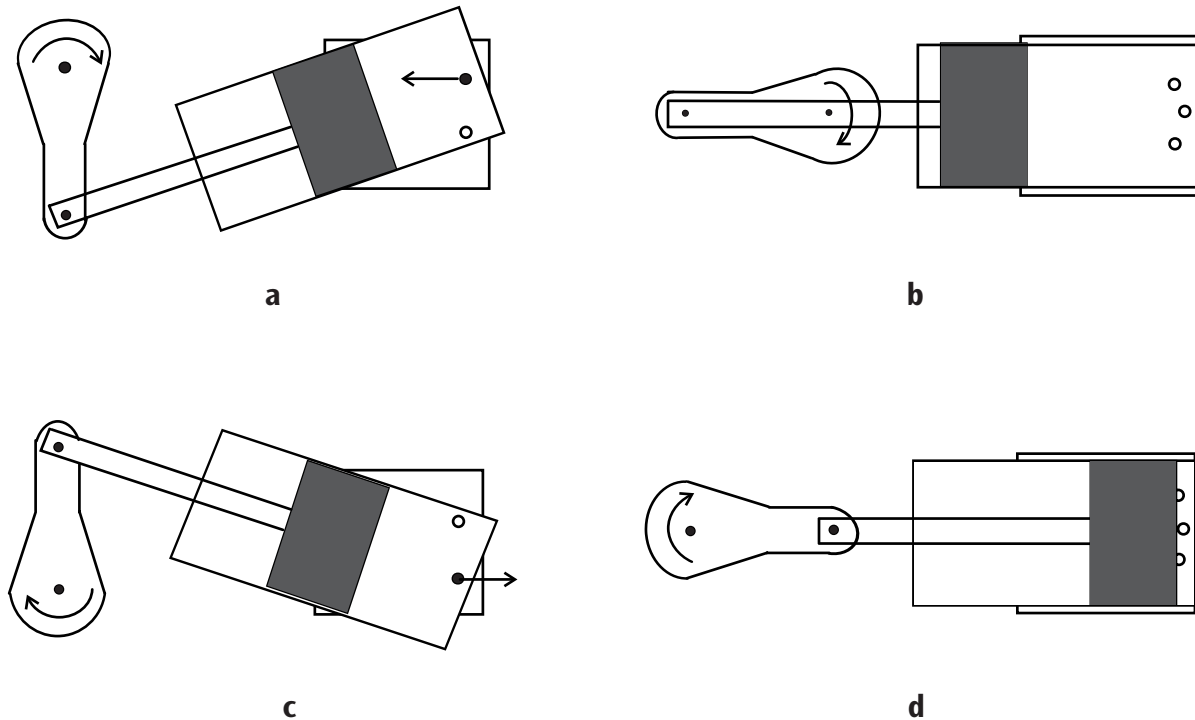


Fig. 1: Work cycle of an oscillating steam engine

#### 4. Operation

- Open the boiler cap ⑭ and fill up the boiler with distilled water (demineralised water conforming to VDE 0510). Do not fill up the boiler to the brim, maintain an air column of approx. 5 mm. The steam engine functions equally well even if the boiler is only half-filled. Only the operating duration is correspondingly reduced.
- Light the wick of the spirit burner and heat the boiler.
- Shut the steam inlet opening to enable quicker build up of pressure.
- After approx. 2 minutes, the water in the boiler begins to boil. From this point onwards, only approx. 2-3 minutes are needed to attain the required operating pressure. Steam flows via the steam feeding hose into the steam inlet opening. Excess condensed water drips into the condensate beaker via the drainage hose ③. For this purpose, channels that facilitate collection and transfer of the condensed water are milled into the frame.
- The engine can now be operated by turning the flywheel in a clockwise direction (while observing the main cylinder).

- The power of the engine decreases if there is not enough water left in the boiler. It is not permitted to heat the boiler if it is not filled with water. The spirit burner should, therefore, be extinguished at the appropriate time.
- Do not blow out the flame in the proximity of the boiler. Use the attached cap to extinguish the flame.
- During the cooling process, condensed water is sucked up from the condensation beaker via the condensation hose, frame and steam feeding hose and transferred into the boiler.

#### 5. Storage and maintenance

- Store the steam engine in a dust-free place.
- To clean use a damp cloth, if necessary, with some washing-up liquid. Never use solvents or aggressive cleaning agents to clean the acrylic glass components.
- Frequent use of the apparatus may cause a layer of soot to deposit on the underside of the boiler ⑮ due to the constant play of a flame. This, however, can be dissolved and removed by using a cloth soaked in acetone.
- In order to prevent water stains appearing, dry thoroughly after cleaning.